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THE CHALLENGE OF THE FUTURE TO MEDICAL EDUCATION[1]

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I

WE meet to-day to mark the completion of a century of developing medical education in this commonwealth, to remember with respect and gratitude those who had a notable part in its growth, to appraise the fruits of progress and to look forward, as prophetically as we may, to the future.

Last night we had a spirited and eloquent outline of the heritage of this state in medical education. The line runs far back into the great sources of modern medicine in London and Edinburgh, and has come down through generation after generation of worthy and able men. The central thread of high idealism has held firm, and decade after decade has shown growth and vigor. That I was privileged to touch intimately the lives of some of these men—Starling Loving and Francis Landacre—will always be a treasured memory. To these and all the noble pioneers of medicine in this region we owe a lasting debt. Let us say of them, in the words of the son of Sirach, "They gave their counsel with understanding, and were wise in their words of instruction. All these were honored in their generation, and were a glory in their day. There are some who have left a name, so that men declare their praise; and there are some who have no memorial, . . . yet these were

[1] Address given on March 2, 1934, as the special University Convocation, on the occasion of the centenary celebration of the College of Medicine, of the Ohio State University.

merciful men, and their uprightness has not been forgotten."

At such a time as this, it is prudent to look forward as well as backward, trying to see something of the country through which the stream of our common life and work is to carry us. A good deal of the landscape is hidden around the bends of a winding course; but we owe it to our safety to look ahead, for the current is running faster and faster, the surface is rougher than it used to be, and the hazards of the passage multiply as we sweep on.

During the past hundred years or so a series of new events has come into the collective experience of mankind in such sort and degree that for most of the practical setting and circumstance of life the old earth has passed away, and a novel, somewhat baffling world has become our troubled home. These changes have occurred at different times and have moulded social structures in differing ways; some of them were beginning to operate a century ago, in the dawn of the industrial era; others are more recent and therefore more disturbing. Any reading of the days and years ahead must be done in the light of these happenings and must take into account, no less, the fact that never before in history has humankind faced together problems so perplexing and knotty as those we must struggle with to-day. The things that have brought about the new order may be roughly summarized in some such fashion as this:

The expansion of control over physical environment. One needs not to debate this point; it is only to be stated. The growth of speed, the partial blotting out of time and space, artificial changes in the vegetation of the world, in climate, in the productivity of land; all these are silent witnesses to the tightening grip we hold upon the treasure and substance of nature. As the century has rolled around, the enlargement of this dominion through man's skill and knowledge has had other issues.

Of these, the expansion of population is an indirect result. Within the past two hundred years the number of people in the world has doubled; empty lands have been taken up; conquests of new territory have been made. We come now near to the point of populational saturation. In most if not all of the countries of Europe there is to-day little change in the number of inhabitants, and it is estimated that in the United States our birth rate and death rate will reach a balance in the year 1960 or thereabouts. Even now the pendulum is slowing, and society is beginning to feel the anxiety of a new situation for which it is unprepared. The question of population will be an important item in any guess about the future of medicine and education in this country, and to this question we must return presently.

The expansion of power and productiveness that has come out of the creative imagination of men during the past few generations suggests the Arabic fable of the djinn, who, when he escaped from the bottle that had been his prison for ages, amazed and terrified the unhappy mortal whom he was bound to serve. The recent leap in the production of all-but-unlimited power, the vast output of goods, the replacement of men by machines—all this that seems to be the blessing of prosperity and enterprise turns out to have a dubious, indeed, a dangerous aspect.

For while the things I have listed are properly to be counted as desirable assets of world culture, the liabilities are not to be forgotten:

(1) The lag of social forces, the tardiness of ethical insight and practise. Something is missing in a sequence that seems logical enough; if great reservoirs of energy have been tapped and their power harnessed to the creation of huge stores of food and clothing and shelter; if we know how to make time dwindle and to shrink space, if we can move mountains—not, alas, by faith but by thunderbolts and chemistry, why are so many millions of men in idleness and want, instead of being, as one might reasonably suppose, in leisure and well-being? Apparently no one knows the answer, even dimly, to a problem so far-reaching, so intricate and obscure; but it is evident that certain things have failed to happen. The new environment has not produced a new society, for the individual units of society have not altered to keep pace with a changing world. Wisdom and charity have loitered behind skill and inventiveness; the ferment of moral idealism has gone meager and watery. Great things that might forward the happiness and contentment of mankind as a whole have been held back by blind self-interest or by still more sordid urges.

(2) The incredible disaster of a war which beggared the world not only of its goods, but of its infinitely precious store of human lives and beliefs. In large part, certainly, the dislocations of government, of commerce, industry and distribution, of markets, exchange and trade, are the price of that unbelievable folly, no less than the ceaseless threat of residual fear and hatred. No optimism can dispel the shadow of a calamity that darkens the happiness and welfare of our children's children, and from beneath that shadow we must view the future.

II

All this may seem to be a cosmic approach to a petty piece of business. Medical education is concerned only with a few thousand young men and women, together with a handful of those who are charged with preparing them for professional life.

There are several reasons, however, why one looks at the changing order of the world as a whole in order to prophesy in part. In the first place, the

problems and products of medical education are closely knit to medical practise, and through it to the thoughts and interests of society at large. The primary business of medical training is to equip physicians who will look after sick people intelligently and effectively, and between whiles do what they can to forestall illness. I scarcely need to remind such an audience as this of the marked alterations that are taking place in the forms of medical and nursing service, or of the extent to which the public has been troubled about their availability and cost. There lies back of this growing interest a long process of patient education by a multitude of agencies. Organized medicine, be it said to its credit, has done much in this direction; local, state and federal governments have worked and interworked through schools, public health services, children's bureaus, hospitals and scores of other units, to fix in people's minds such things as the importance of physical well-being, why and when a doctor should be called, common sense about diet and sunshine and temperance in all things. Frankly commercial advertising has played no small part in this form of education, taking particular advantage of radio broadcasting. The result, far as it is from being satisfying, shows an amount of mass thinking in the field of constructive health that could not have been dreamed of a generation or two ago. This is particularly apparent as applied to the rearing and care of children. The general consequence is that there is a fast enlarging body of well-informed people who know a great deal more about what they require in the way of medical guidance than their parents did, and who will be much more discerning in their claims upon the doctor. Such changes in current thought and attitude come about gradually and almost insensibly, but they are real, and sink deep into our social consciousness. A new sort of clientele is emerging for the physician of the future, and our society is thinking about medicine as it never thought before. It is not alone that folk are getting different notions and that the reach of education is wider (particularly in the last twenty years), but that physical environment is altering greatly; hard roads, fast cars, the rapid sophistication of small towns, the disappearance of frontier life, all tend to create new circumstances which will have to be met by the young doctor with all the social and intellectual pliability at his command.

In the second place, the approaching limit of population will modify not only the output of medical graduates, but will tend to change very definitely the nature of medical service. There are going to be fewer children born, and fewer will die in childhood. The babies that do appear will be important to society out of all proportion to their numbers. Problems of nutrition and infectious disease in the young, and of degenerative diseases in the old, are likely to be the focus of the medical practitioner's concern after a generation or two.

But there is something else to be weighed. The biological sciences have not yet discharged their full debt to progress. We look with satisfaction at the widening borders of medical knowledge; it is easy to become complacent about the rapid advances of our science, about the conquest of preventable diseases and the lengthening span of life. But look at the other side of the shield. More than half of the institutional beds in the United States are now permanently occupied by individuals who are gross biological deficits, as far as society is concerned. The burden of financial care for these dependents is slowly but surely strangling the productive fraction of society that pays for their maintenance. For the time being we look upon this as another uncomfortable burr of taxation under the saddle that the solid citizen wears, but in the end, of course, it is basically a problem of human biology, which must be solved either by the calm wisdom of foresight or under the pressure of despair. The planning of a population made as free from the menace of biological incompetents as our tested knowledge can make it lies far ahead, perhaps, but in that direction a step will be taken one day that will endow our race with unimagined powers and opportunities.

Other great areas have yet to be illuminated; we are still frustrated by diseases that take their toll from the later years of life, and their study must concern us more and more; the place of psychic stress not only in functional ailments but in organic disorders needs further exploration. Psychiatry must have a new meaning for the physician. The problems of human disease must be approached, also, by methods involving higher refinements of measurement, by quantitative and precise procedure rather than by the gross or qualitative ones now in use.

These are random samples of scientific trends and social requirements that will demand from the doctor of the future skill and techniques and imagination beyond our present capacity. It is enough for my purpose to indicate these needs and to point out again that the medical problems of the future will be of social rather than individual concern, and will have to do with maintenance rather than with repair. I do not mean that the doctor is likely to be remote from his patient in any degree, but I do mean that medical service is coming more and more to be a function of society and to be untilized purposefully for the needs and aims of the community as a unit. Whatever one thinks or fears about the socialization of medicine and its perils, the actual facts should be philosophically faced. There is not going to be any

disappearance, I feel sure, of the private practise of medicine, but it may be much more limited than is now the case, when we come to the point of making available to every one needing it the best quality of medical care.

In summary, the elements of change in applied medical science to which I direct your attention are these: (1) An altering attitude of society toward its medical needs; (2) a population nearing stabilization, with low birth and death rates; (3) deviations in the occurrence and nature of the commoner diseases; (4) progressive urbanization of town and country.

III

The aim of medical education, I have suggested, is basically the preparation of young people who can care for the sick with intelligence and skill. In the light of a rapid shifting of the social order which has just been sketched, however, there is more to be said about the training of these young doctors. Country life, we agree, is all but gone; people are leading essentially a city and suburban existence; except for minor areas scantily inhabited, there are no medically inaccessible spots in this country. Our population is gradually but perceptibly slowing to a balance. If one takes these facts into account, and studies the present acute problems of the practitioner, there is no escape from the conclusion that more doctors of medicine are being turned out than society needs or can comfortably reward. The situation is perturbing enough now; the shrinkage of savings during these bad times has been disastrous for the physician, because it is from this margin, generally speaking, that he is paid, and when that disappears he gets little or nothing. Even with a moderate revival of business, if population settles gradually to a balance (as it certainly will), and if the stream of incoming practitioners is larger every year (as seems likely), there is no relief in sight. The time is coming, however, when it will be plain to every one that the principal functions of medical service can be effectively furnished by half the number of medical graduates we now have. Here is the first problem of the new day of medicine—the wise selection of fewer students.

There appears to be a wide-spread notion that to close educational doors of any kind to ambitious youth is undemocratic and un-American; that if a young man wants to study medicine and can pass the usual examinations he should be free to do so. I hazard a guess that the future will show this to be unsound doctrine and that the truly democratic process will be to take more thought about the good of the whole, and less about the special satisfaction of the few. Our present system not only opens the responsibilities of medical service to a larger number than can support themselves properly, but to many who have not the basic qualifications for the study and practise of medicine. I contrast basic qualifications with formal eligibility, which is our ordinary yardstick. How many credits has the candidate? What courses has he had in languages, chemistry, physics, zoology? What is the weighted average of his grades? Let us not sniff at these questions. They are important, but they are not fundamental. It is much more to our purpose to know that the prospective medical student has an alert, smooth-working, imaginative mind, that he has physical vitality to endure heavy strains and still be able to communicate to others a sense of reserve power, that he has morals—not in a flabby nor pietistic sense, but in the meaning that he has a grip on intellectual honesty, integrity, perseverance, loyalty, devotion, insight—all those imponderables that go to make up a noble personality. Is he to be the kind of person who can deal effectively with sick lives as well as damaged organs or impaired physiology? For the time being we are balked in determining fitness upon these hopeful bases, partly because they do not lend themselves to measurement or comparison, and partly because in young natures, not wholly mature, such qualities may be hidden rather than evident.

What systems of selection will be found to fit the need I do not know, but their discovery is one of the conditions of progress. Just as society must protect itself in the future by enlightened means from those who are grossly unfit biologically, so must the door to the practise of medicine be closed to the stupid and venal, and opened to fewer men and women than it has been in the past—not to create a monopoly for the elect, but to relate the workers rightly to the work that is to be done. To those who say that this proposal sounds undemocratic and unworkable it is fair to retort that it operates successfully now in one of the enlightened democracies of Europe. But, however desirable such a regulation may be, we shall have to admit that it will be hard to achieve in this country because of prevalent ideas of the place of advanced education in our form of polity, and because of the lack of power in the federal government with respect to medical affairs.

IV

I suggest the studied sifting of prospective medical graduates and a reduction of their number in proportion to the general population as the most important forward movement of medical education. It is not that medical students of the highest types are not already in our schools; they are, but there are still too many whose performance will never come up to the needs and expectations of society and who will be a constant drag upon their abler colleagues.

Let us turn to another deficit of medical education which the golden future may find a way to supply. The physician of tradition was a man of learning; the educational drift of to-day tends to produce men of skill and highly specific knowledge. It goes without saying that technical skill is essential, but it is not enough. The practitioner of medicine must know not only diagnosis, but men; he must be in the highest sense of the words a man of the world, leading a life enriched by close touch with the interests and affairs of humanity. The eager and questioning minds that are to be called into medical practise in the days ahead are going to be responsive to this need, and in some way the vitamins of a more varied learning, so necessary to growth, are going to be added to the monotonous intellectual diet of science on which the premedical student is chiefly nourished to-day.

The expression of a parallel need in the program of professional preparation is to be found in the painstaking studies of the Commission on Medical Education. After discussing the factors that have been altering medical practise so greatly within the past generation, the report goes on to say that without attempting "a prediction of the form that medicine will assume in the future" the commission feels it to be "apparent that conditions of practise to-day are different from those of the past, and are likely to be different in the future." It is important, therefore, "inasmuch as medical education is primarily concerned with the qualification and preparation of students to practise medicine, that the training be permeated with an understanding of the larger social and economic problems with which medicine must deal, and which are likely to influence the form and opportunities of practise in the future. . . ." "The preparation of students for the newer obligations of the profession requires a sound training in the principles of the basic sciences which are likely to remain the foundation of medical practice; . . . the training should emphasize, however, that the forms and methods by which these principles are to be applied in meeting the needs of individuals and the community are likely to be modified in the future." These needs and the responsibilities of practise have already changed materially "not only in regard to technical matters, but also in the larger concept of public relations." Here is a clear call to recast the attitudes of medical faculties toward the social functions of practise. It needs no gift of prophecy to say that by all but a few reactionary groups, who will insist on looking upon medical practise as commerce and organized medicine as a trade union, the call will be heeded.

V

I have done with prescriptions for the future. If we can have the right number of the sort of young people I have been talking about, and can devise ways in which, when they have finished their training, they can be reasonably accessible to those who need them, the other vexations that are afflicting medicine to-day will gradually vanish. The turmoil of anxious emotion about state and socialized medicine comes out of economic fear and uncertainty, and most of that in turn arises from an overcrowded and ill-distributed body of doctors. Medicine is sure to become much more socialized than it is now, but it can do so with advantage and without endangering anything vital to high standards.

The kind of educational program I have sketched calls for no new great endowments nor new plants nor large outlay of money. We have buildings and funds and equipment in abundance and high quality. Medical education and research have lived well for a generation, and have acquired stately mansions. We have, above all, admirable faculties. A superb piece of educational work could be done if we were to use only half of the sixty-odd medical schools in the United States. What is needed is courage and tenacity in the bending of educational processes to great social ends. An ancient Chinese proverb says that a medicine which does not make a commotion in the patient can not be expected to cure the disease. The drastic dose I am suggesting will upset the inwards of professional education, certainly, but if the diagnosis is right, it should relieve the malady.

The things that medical deans and their colleagues used to worry over, and bicker about, are fading away; part-time and full-time professorships, the extent and content of curricula, credits and electives—all these sources of anguish are drying up, as time and experimentation deal with them. The techniques of medical education are good to-day; they will be better to-morrow. What we must concern ourselves about is the student of medicine to-day, the doctor of to-morrow. Neither he nor the social group he is to serve should be let down by what we may do—or still worse, leave undone—in the bewildering swirl of events in which our thinking and planning has to be done.

VI

We look ahead hopefully to better things. Let us not be misled by the grim and gloomy philosophy that thinks of man as a cheerful imbecile, sweating to raise himself above the generation just past, only to see himself surpassed by the one next ahead, and so on into an infinite recession of betterment—a creature "inferior, fatally, to all the future." To accept as folly the divine restlessness that struggles ahead would be to deny our very birthright. For progress, won by agony and tears, is the law of human kind; it is "man's distinctive mark alone;

> Not God's and not the beasts,
> God is, they are—
> Man partly is and wholly hopes to be."

It is in this attitude of expectation that we may, I think, look confidently forward to see at no great distance the science and art of medicine meeting more effectually than it ever has done before the challenge of a changing world.

SCIENCE AND CONSERVATION[1]

By Dr. JOHN C. MERRIAM
CARNEGIE INSTITUTION OF WASHINGTON

THE conservation movement in the United States has passed through three principal phases. The first two concern the idea of protection as designed to prevent destructive exploitation and undue concentration in private hands of properties derived from public ownership. The third phase relates to development of the highest use of resources. Exceptional illustration of this third aspect of conservation is given in discovery of new modes of utilization for petroleum. From consumption through burning of oil for light or fuel we attain a stage in which these products find a vast range of application in all manner of chemical compounds valuable for industries as also those having special application for medication.

The relation of science to conservation has been important in all these phases. There has been large contribution in determining the occurrence and nature of natural resources. This has enabled us to harvest or gather the materials in such manner as to limit waste. In consideration of new uses science and engineering have had leading parts. These advances were made possible both by extensive application of available knowledge and by new researches in chemistry, physics, biology and many other fields of science. This program gave a vast number of products which have helped to make life more agreeable and more profitable. It increased the types of employment and extended the range of human interests. It is a responsibility of science to devote itself in the most effective way to fundamental and to applied research which may extend the uses of the vast resources with which this country is blessed.

The term conservation has widened from its original narrow limits to express in a great variety of ways activities which have to do with maintenance and extension of values in many types of human activity. As a second phase of this discussion, I think it important to call attention to certain conservation aspects of the great educational program upon which advance of science depends.

In our educational system we attempt to furnish for youth a concentrated statement of available information and experience and to give a point of view which will make possible the most thoughtful and constructive attitude toward life. With particular reference to science, we present an outline defining in some measure the nature of the materials and the forces which constitute the scene of human life. We are now beginning to realize that this effort depends for its success upon our ability to develop a program which will maintain its value through the period of maturity. To state the problem in another way: we support an educational system which should have continuing and increasing influence upon later life, and we find that unless special means are developed for maintenance of this influence, a large part of the original effort is lost for the period in which it should be most effective. The broad plan for continuing education of the adult to-day is designed in a measure for conservation of the values secured in early education. Along with this influence we seek to open the way for evolution or development of the individual through his whole life.

As a third phase of this statement, it is important to call attention to the fact that we need, just at this time, to protect as fully as possible the exceptional opportunity which has come to science and research for bettering conditions of life in nearly every aspect of human activity. With science in the wider sense, including natural science, social science and governmental science, having won high place in the world, we have reached a stage at which question is raised insistently as to possible disturbing influence of science and research upon the course of civilization. It is stated frequently, and from many directions, that the influence of science is in large part responsible for the difficulties in which the world finds itself to-day. We discuss seriously whether science is an asset or a liability. We consider the possibility that a moratorium be established on research.

From my point of view there is no doubt that the opportunities offered for creative work are essential for maintaining the happiness of mankind. In one aspect of the question research may be considered the hope of a changing world, in that it offers a continuing supply of new materials with which to build and opportunity for adequate adjustment to shifting conditions. Seen from another angle, there is no doubt that the introduction of new ideas, however

[1] Remarks before the National Academy of Sciences, Washington, D. C., April 24, 1934.

valuable they are intrinsically, unless guarded with extreme care, may produce unfortunate situations. What we call unemployment may be a result, not because research necessarily leads to unemployment but because of the difficulty in attaining immediate adjustment to things which may have great basic values for mankind.

The situation which arises through introduction of new ideas in a world which has not been prepared for them is in some respects not unlike that which may occur in bringing a new biological element, or an element from another region, into a part of the world adjusted through millions of years to a particular biological balance. The mongoose was introduced into Jamaica in order to kill rats. The experiment proved that the mongoose also kills all ground birds and destroys nests and may become an intolerable pest. The rabbit, a peaceful and in many ways useful creature, brought into Australia becomes a serious problem. So a new idea brought into use through physics or chemistry or study of social theory may come into a world not yet prepared for its use, and unless carefully guarded may contribute toward development of an unbalanced situation.

With reference to the possibilities of unbalance, it is my feeling that we are faced at this moment with a need for what might be called conservation of opportunity for science. With the way open for enormous contributions, which may well bring blessings to mankind, we must protect or conserve the positive opportunities for advance through warding off dangers which might lead to restriction of constructive science. The situation of science is endangered by failure to set up such relations as will furnish the most careful guidance in the introduction of new elements arising from creative work. This protection, or conservation, of the opportunity for great achievement, which intelligence has gained after fighting its way through tens of thousands of years, is one of the greatest needs of the moment. Development of means for adjustment in this situation depends in part upon those who study mankind from the point of view of social sciences, in part upon economists and in part upon students of government. There is also an unavoidable responsibility resting upon science itself so to fit the contribution which it makes into the general scheme of human life as to give the greatest advantage with the minimum of possible disturbance.

SCIENTIFIC EVENTS

CONVERSAZIONE OF THE ROYAL SOCIETY

The Royal Society held a *conversazione* at Burlington House, London, on May 9. According to the London *Times,* a large number of exhibits were on view, illustrating the most recent developments in pure and applied science, and lectures and demonstrations were given by the various exhibitors.

Professor G. I. Finch and Imperial Chemical Industries (Alkali), Limited, showed the precision electron-diffraction camera designed by Professor Finch and Dr. Quarrell in conjunction with the research staff and constructed in the workshops of the Winnington Laboratories. Dr. C. D. Ellis and W. J. Henderson conducted an experiment to show the production and decay of the new radioactive elements discovered by Joliot and Curie, while Dr. Oliphant demonstrated the transmutation effects observed when protons and diplons are used to bombard layers of lithium and of heavy hydrogen.

A fractional seconds chronograph, exhibited by the mathematical department of the Imperial College of Science, records on paper tape 1-100ths of a second at 1-10th inch scale up to four events simultaneously, by means of a tuning fork controlling a synchronous motor which, through a three-speed gear, gives motion to a printing train and paper feed. The instrument is portable and worked from a 12-volt accumulator. Part of a new apparatus to determine the length of the meter and the yard in terms of wave-lengths of light was shown by the National Physical Laboratory, with demonstrations of the application of circular interference fringes produced in cadmium radiations measured by an étalon approximately 1-12th of a meter in length, and of the comparison of optical lengths by means of Brewster's fringes produced in white light passing through this étalon and another of one third of a meter.

Studies of coal particles and coal suspensions were provided by the Fuel Research Station, while the Metals Research Association explained the control of structure and soundness of ingot of non-ferrous metals, with particular reference to the effect of casting conditions on brass ingots and the causes and remedies of unsoundness in aluminium alloy castings. A large range of specimens of metallurgical interest, illustrating applications of ferrous metals and alloys, was shown by Sir Robert Hadfield.

Among those present were: The President of the Royal Society (Sir Frederick Gowland Hopkins), Sir Henry Lyons (treasurer), Sir Henry Dale, Sir Frank Smith, Lord Rayleigh. Lord Cecil of Chelwood, the president of the Royal College of Surgeons, Sir Buckston Browne, Sir Hubert Bond, Sir Ernest Benn, Sir William Bragg, Sir Frederick Berryman, Sir Lenthal Cheatle, Sir Patrick Duff, Sir Frank Dyson, Sir Archibald Deury, Sir John Flett, Sir

Martin Forster, Sir Richard Gregory, Sir Thomas Heath, Sir Clement Hindley, Sir Herbert Jackson, Sir Henry Miers, Sir Peter Mitchell, Sir John Parsons, Sir Robert Robertson, Sir Isidore Salmon, Sir Gilbert Walker, Sir Cuthbert Wallace, Major-General R. B. Ainsworth and Emile Mond.

EXPEDITION OF THE DEPARTMENT OF TROPICAL RESEARCH OF THE NEW YORK ZOOLOGICAL SOCIETY

THE twentieth expedition of the Department of Tropical Research of the New York Zoological Society, under the directorship of Dr. William Beebe, left New York in May for the sixth year of continuous oceanographic work at Bermuda. After a lapse of a year, the exploration of ocean depths in the Bathysphere will be resumed. This work has been made possible by a grant of funds for the purpose by the National Geographic Society of Washington. Six hundred more feet of cable will permit a descent to 3,000 feet, and new oxygen apparatus will allow the time limit to be extended to five hours.

The dives in the Bathysphere will take place in July when best weather conditions are most likely. The earlier program includes further work on deep sea fish and on the occurrence and development of pelagic fish eggs. Headquarters will be established at the Bermuda Biological Station, the field work being carried on at the Zoological Society's laboratory, New Nonsuch and on the chartered vessels, *Gladisfen* and *Ready*.

In addition to Dr. and Mrs. Beebe, the group which sailed for Bermuda included the regular staff of the department, John Tee-Van, Gloria Hollister and Jocelyn Crane. Mr. Otis Barton, two artists and two Dartmouth graduates will follow later.

The Bathysphere is now in New York undergoing a thorough reconditioning by the generosity of the Air Reduction, the General Electric, the Bell Telephone and the Watson-Stillman Companies.

FELLOWSHIPS OF THE NATIONAL RESEARCH COUNCIL

THE Fellowship Board in Physics, Chemistry and Mathematics of the National Research Council at its meeting held late in April made appointments and reappointments for a second year as shown by the attached list:

APPOINTMENTS MADE APRIL 22, 1934

REAPPOINTMENTS—None to Exceed Eight Months

Physics

Allen, John F. (Ph.D. Toronto, 1933)
Bradley, Charles A. (Ph.D. Columbia, 1932)
Heydenburg, Norman P. (Ph.D. State Univ. Ia., 1933)
Kurie, Franz N. D. (Ph.D. Yale, 1932)
Lewis, Charlton M. (Ph.D. C. I. T., 1933)
McKellar, Andrew (Ph.D. California, 1933)
McMillen, James H. (Ph.D. Washington, 1930)
Parratt, Lyman G. (Ph.D. Chicago, 1932)
Shortley, George H., Jr. (Ph.D. Princeton, 1933)
Van Atta, Chester M. (Ph.D. New York U., 1933)
*Wheeler, John A (Ph.D. Johns Hopkins U., 1933)
Whitford, Albert E. (Ph.D. Wisconsin, 1932)

Chemistry

†Bear, Richard S. (Ph.D. California, 1933)
Benedict, William S. (Ph.D. M. I. T., 1933)
Cross, Paul C. (Ph.D. Wisconsin, 1932)
Deitz, Victor (Ph.D. Johns Hopkins U., 1932)
Gilfillan, Edward S., Jr. (Ph.D. Harvard, 1932)
Hicks, John F. G., Jr. (Ph.D. California, 1933)
Hultgren, Ralph R. (Ph.D. C. I. T., 1933)
Kimball, George E. (Ph.D. Princeton, 1932)
†Sherman, Albert (Ph.D. Princeton, 1933)
Smith, Howard A. (Ph.D. Illinois, 1931)
Spielman, Marvin A. (Ph.D. Minnesota, 1933)
Trenner, Nelson (Ph.D. New York U., 1932)
Wright, George F. (Ph.D. Iowa S. College, 1932)

Mathematics

Barber, Sherburne F. (Ph.D. Rochester, 1933)
*Blumenthal, L. M. (Ph.D. Johns Hopkins U., 1927)
Cameron, Robert H. (Ph.D. Cornell, 1932)
Hull, Ralph (Ph.D. Chicago, 1932)
Lewis, Daniel C., Jr. (Ph.D. Harvard, 1932)
Montgomery, Deane (Ph.D. Iowa, 1933)
Nathan, David S. (Ph.D. Cincinnati, 1933)

NEW APPOINTMENTS—For a Period of Twelve Months

Physics

Bonner, Tom W. (Ph.D. Rice, 1934)
Brown, Frederick W. (Ph.D. Illinois, 1933)
Jacobs, Robert (Ph.D. C. I. T., 1934)
Jordan, Edward B., Jr. (Ph.D. California, 1934)
Serber, Robert (Ph.D. Wisconsin, 1934)
Shaw, Charles H. (Ph.D. Johns Hopkins, 1933)
*Uehling, Edwin A. (Ph.D. Michigan, 1932)

Chemistry

Benedict, Manson (Ph.D. M. I. T., 1934)
Frevel, Ludo K. (Ph.D. Johns Hopkins, 1934)
Gould, Robert G., Jr. (Ph.D. Harvard, 1933)
Gulbransen, Earl A. (Ph.D. Pittsburgh, 1934)
Helmholz, Lindsay (Ph.D. Johns Hopkins, 1933)
Long, Earl A. (Ph.D. Ohio State, 1934)
Steffens, Carsten C. (Ph.D. C. I. T., 1934)
Voge, Hervey H. (Ph.D. California, 1934)

Mathematics

Martin, William T. (Ph.D. Illinois, 1934)
Murray, Francis J. (Ph.D. Columbia, 1934)
Myers, Sumner B. (Ph.D. Harvard, 1932)
Robertson, Malcolm I. S. (Ph.D. Princeton, 1934)
Webber, G. Cuthbert (Ph.D. Chicago, 1934)

* May work abroad on U. S. basis.
† For *four* months.

THE FIFTIETH ANNIVERSARY OF THE FOUNDING OF MEMORIAL HOSPITAL, NEW YORK CITY

THE fiftieth anniversary of Memorial Hospital, which treats cancer and allied diseases, was celebrated on May 24 and 25. On the evening of May 24 there was a scientific meeting on cancer at the New York Academy of Medicine and on Friday there was a series of round-table scientific discussions at the hospital, followed by a dinner at the Waldorf-Astoria.

At the academy meeting Dr. John A. Hartwell, director of the academy, spoke on "The Place of a Cancer Institute in Medical Organization." Dr. Robert Greenough, president of the American College of Surgeons, described the "Organization of Cancer Service in General Hospitals."

Dr. C. C. Little, managing director of the American Society for the Control of Cancer, spoke on "Heredity in Cancer," and Dr. E. C. Dodds, director of the Courtauld Institute of Biochemistry of Middlesex Hospital, London, spoke on "Cancerigenic Agents."

A dinner was given in the evening of May 25 at the Waldorf-Astoria Hotel, which was attended by about 400 friends and staff members of the hospital, at which a letter of congratulation from President Roosevelt was read by Harry Pelham Robbins, president of the board of managers, who presided.

The letter follows:

The White House, May 11, 1934.

I shall be grateful if you will express to those who gather to celebrate the fiftieth anniversary of the founding of the Memorial Hospital my cordial greetings and congratulations on the attainment of this milestone.

This institution is nationally notable not only because it was the first special hospital of its kind in the United States but because its human clinical research and service in the field of cancer and allied diseases have made the whole country its debtor. Its consistent effort to advance the knowledge and control of a disease which stands second in the list of causes of death renders the work of the hospital of outstanding importance.

I wish for the institution and all those associated with it the fullest fruition of their hopes and efforts in the continuance of this indispensable service.

Speakers at the dinner were Dr. James Ewing, chairman of the medical board of Memorial Hospital; Dr. E. C. Dodds, director of the Courtauld Institute of Biochemistry of Middlesex Hospital, London; Dr. Livingston Farrand, president of Cornell University; Mrs. Robert G. Mead, of the New York City Cancer Committee; Dr. Dean Lewis, president of the American Medical Association, and Dr. Clarence C. Little, executive secretary of the American Society for the Control of Cancer.

The cornerstone of Memorial Hospital, then the New York Cancer Hospital, was laid May 17, 1884, after plans had been drafted February 7 at the residence of Mrs. Elizabeth Hamilton Cullum, a granddaughter of Alexander Hamilton, who was associated in the hospital's founding with Mr. and Mrs. John Jacob Astor. The first building erected was the Astor Pavilion. The hospital was opened December 6, 1887.

In 1912 James Douglas, then president of the Phelps Dodge Corporation, gave $100,000 for the endowment of twenty beds for clinical research and the equipment for an x-ray plant and clinical laboratory, which was opened in 1917. He also gave three and a half grams of radium for the study of radium treatment of cancer. Dr. Ewing was appointed president of the medical board in 1913, and seven years later a social service department was established by Miss Gertrude Hill and Burton J. Lee.

Edwin Gould gave $50,000 in 1926 for erection of a new x-ray building, and Edward S. Harkness at the same time gave $250,000 for the purchase of radium. A year later John D. Rockefeller, Jr., made the first of his annual $60,000 contributions for research and the establishment of six clinical fellowships.

THE GENERAL SESSIONS OF THE AMERICAN ASSOCIATION AT BERKELEY

THE general sessions of the summer meeting at Berkeley, which will be held from June 18 to 23, constitute a series of marked interest. The first evening, Monday, will be occupied by the retiring address of the president of the Pacific Coast Division of the association, Dr. Joel H. Hildebrand. Dr. Hildebrand has taken for his subject "The Liquid State."

Tuesday evening the executive committee decided to devote to a lecture under the terms of the Hector E. Maiben Lectureship. This was established in 1933 under the terms of the bequest made by the late Hector E. Maiben. Mr. Maiben became a sustaining member of the association in 1921. Ten years later when his will was filed it was found that he had bequeathed all his property, some $40,000, to the association. After careful consideration the executive committee voted to establish with this fund an annual lectureship to deal authoritatively with some subject of great scientific interest, to be addressed to men and women interested in the advance of science in general rather than to special workers in the field covered by the lecture. The first Maiben lecture was given at the Atlantic City meeting by Dr. Henry Norris Russell, of Princeton University, who spoke on "The Constitution of the Stars." The second Maiben lecture was given at Boston by the late Dr. William Morris Davis, who spoke on "The Faith of Reverent Science."

By the terms of establishment a Maiben Lecture is to be given at each annual meeting. In view of the

fact that the Berkeley meeting is a joint affair including the Pacific Coast Division as well as the association generally, the executive committee decided to include in the program a Maiben Lecture also.

The committee took advantage of the presence in this country of the distinguished English scientist, Dr. L. Dudley Stamp, geologist and geographer, now on the faculty of the University of London, and as chairman of the Commission on Land Utilization actively concerned in the study of land utilization in England. It was felt that a discussion of this problem was most timely in view of present movements in our own country. Dr. Stamp will speak on Tuesday evening on "Planning the Land for the Future."

On Wednesday, Dr. J. C. Merriam, of the Carnegie Institution of Washington, will speak on "The Responsibility of Science with Relation to Governmental Problems." On Thursday evening, Dr. E. B. Wilson, of Harvard University, will discuss the question "Are There Periods in American Business Activity?" On Friday evening, Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, will speak on "Science and Prosperity." The last three speakers are too widely known as leaders in the field of science to need any further comment on their work.

In view of the fact that the president of the association, Dr. Edward L. Thorndike, finds it impossible to be present at Berkeley, Dr. W. W. Campbell, president of the National Academy of Sciences, past president of the American Association and president emeritus of the University of California, has agreed to preside on Monday and Tuesday evenings, and on behalf of the association to arrange for presiding officers for the following general sessions.

SCIENTIFIC NOTES AND NEWS

It is stated in *Nature* that Professor H. L. Lebesgue, of Paris, the discoverer of "Lebesgue integration," and Professor O. Warburg, of the Kaiser-Wilhelm Institut für Zellphysiologie, Berlin-Dahlem, known for his work on cellular metabolism and respiration, were elected foreign members of the Royal Society, London, at the annual meeting on May 3.

Sir Sidney Harmer, formerly director of the Natural History Departments, British Museum, was presented on May 24 with the gold medal of the Linnean Society.

James Cloyd Downs has been awarded the Schoellkopf Medal of the Western New York Section of the American Chemical Society for 1934, because of his work in producing sodium directly from salt. The medal was presented at the meeting of the section on May 8 at Niagara Falls. Following the presentation an address on "The Downs Cell and its Relation to the Sodium Industry" was given by H. M. Gilbert, of the R. and H. Chemicals Division of E. I. du Pont de Nemours and Company. H. R. Carveth, former president of the R. and H. Chemicals Company and also a former associate of Mr. Downs, introduced the medalist.

Lewis Warrington Chubb, director of the research laboratories of the Westinghouse Electric and Manufacturing Company, Pittsburgh, will be presented with the Lamme Gold Medal, awarded annually to an Ohio State University alumnus distinguished in the field of engineering, at the commencement exercises of the university. The medal was established by the late Benjamin G. Lamme, '88, and is valued at $200.

Dr. W. J. Gies, professor of biological chemistry at Columbia University, was recently tendered a dinner by his past students and members of the staff.

A dinner in honor of Dr. John R. Murlin, director of the department of vital economics at the University of Rochester, was given on April 30 by members of the staff, graduate students and other associates, in celebration of the sixtieth anniversary of his birth. A morocco-bound volume of letters of greeting from many of his friends was presented.

Among honorary degrees conferred in commemoration of the centenary of the Medical School of the University of Liverpool was the degree of doctor of science on Professor Henry Roy Dean, professor of pathology, University of Cambridge, and master of Trinity Hall; on Sir Thomas Lewis, University College Hospital, an authority on diseases of the heart, and on Mrs. May Mellanby, investigator for the Medical Research Council and wife of Professor E. Mellanby.

The University of Birmingham will confer in June the degree of LL.D. on Dr. G. T. Morgan, emeritus professor of the University of Birmingham, director of the Chemical Research Laboratory, Teddington, and president of the British Chemical Society; on Dr. C. A. Lovatt Evans, Jodrell professor of physiology, University College, London, and on Sir Harry Duncan McGowan, president and chairman of Imperial Chemical Industries, Limited.

Professor Haven Emerson, of New York City, has been elected an honorary fellow of the Royal Sanitary Institute, London.

Sir Richard Redmayne, formerly inspector of

mines, was elected president of the British Institution of Civil Engineers at the annual meeting in London.

Dr. Harry Woodburn Chase, who succeeded Dr. Elmer Ellsworth Brown as chancellor of New York University, will be formally installed on June 16. Dr. Chase was previously successively professor of psychology and president at the University of North Carolina, and from 1930 until his election to the chancellorship of New York University, president of the University of Illinois.

Dr. Warren J. Mead, of the University of Wisconsin, has been appointed head of the department of geology at the Massachusetts Institute of Technology. Dr. Mead succeeds Dr. Waldemar Lindgren, who retired last June with the rank of professor emeritus after a distinguished career. Since that time Dr. Hervey W. Shimer, a member of the teaching staff for more than thirty years, has been acting head of the department of geology. Alfred V. de Forest, research engineer of Bridgeport, Connecticut, has been appointed associate professor of mechanical engineering.

Professor George E. Simmons, head of the department of agronomy at the University of Maine since 1911, has tendered his resignation to become effective at the close of the academic year, when he will have served twenty-five years as a member of the university faculty.

Dr. Curtis Fletcher Marbut, of the soils survey of the U. S. Department of Agriculture, who was formerly a member of the faculty of the University of Missouri, will return to the university as honorary professor of soils on July 1 to continue his experiments there.

Joseph A. Chucka, associate biologist in the Maine Agricultural Experiment Station, has been appointed head of the department of agronomy and agricultural engineering at the University of Maine.

At Stanford University the following have been promoted to associate professorships: Dr. J. Murray Luck, in biochemistry; Dr. Francis W. Bergstrom, in chemistry, and Dr. Aaron C. Waters in geology.

Announcement is made of the following appointments at the University of Washington Oceanographic Laboratories: Dr. Dora Priaulx Henry, Dr. Martin W. Johnson and Dr. Belle A. Stevens, research associates in zoology; Dr. Lucille A. Liston, research associate in chemistry. Dr. Bertram D. Thomas has resigned as research associate in chemistry and oceanography to accept a position as research chemist with the Battelle Memorial Institute, Columbus, Ohio.

The Carnegie Institution of Washington announces that Dr. Charles B. Davenport will retire on July 1 as director of the department of genetics at Cold Spring Harbor, L. I. Dr. Albert F. Blakeslee, assistant director, will serve as acting director during the remainder of the year. Dr. Davenport has been appointed a research associate for a limited period dating from July 1, in order to facilitate arrangements which will enable him to bring to a stage of report certain special studies on child development and growth.

The Administrative Council of the Pasteur Institute at its meeting on May 16, called for the purpose of choosing the successors of M. Roux and M. Calmette, designated M. Louis Martin, director and M. Ramon assistant director. It also decided to create a Scientific Council composed of M. Bordet, president, and M. M. Gabriel Bertrand, Borrel, Mesnil, Nicolle and Yersin, members. M. Courtray, inspector general of finances, was chosen administrative councilor.

Dr. Carey Croneis, of the University of Chicago, who last year was in charge of the geology exhibit at the Chicago World's Fair, has recently been appointed head of the Hall of Science for the 1934 Century of Progress Exposition.

Dr. Frederick D. Rossini, of the thermochemical laboratory of the National Bureau of Standards, has been appointed to succeed the late Dr. Edward W. Washburn as a member of the Permanent International Committee on Thermochemistry, which body is empowered by the International Union of Chemistry to establish standard values for the important thermochemical constants.

F. J. Sievers, director of the Massachusetts Agricultural Experiment Station and of the Graduate School at Massachusetts State College, has been elected by the United States Trust Company of New York to direct the investigations under the Herman Frasch Foundation for Chemical Research. Research in agricultural chemistry under this foundation is at present being supported at the University of Wisconsin, University of Missouri and the Boyce Thompson Institute.

The officers, executive committee and members of the Division of Geology and Geography, National Research Council, for the year beginning July 1, are as follows: *Chairman,* Edson S. Bastin; *Vice-chairman,* W. L. G. Joerg; *Executive Committee,* Edson S. Bastin, W. L. G. Joerg, W. H. Twenhofel (retiring chairman), E. C. Case, Nevin M. Fenneman and Thomas B. Nolan; *Representatives of societies,* Donald C. Barton and E. C. Case—Geological Society of America; W. F. Foshag—Mineralogical Society of America; August F. Foerste—Paleontological Society; Nevin M. Fenneman and C. F. Marbut—Association of American Geographers; W. L. G. Joerg—American Geographical Society; Thomas B. Nolan—Society

of Economic Geologists; R. S. Knappen—American Association of Petroleum Geologists; *Members at large,* Edson S. Bastin, Mark Jefferson and Morris M. Leighton. Communications intended for the chairman of the division should be addressed to him at the National Research Council, Washington, D. C.

DUE to illness, Professor Edgar Allen, of the Yale University School of Medicine, is unable to carry out his plans of being in charge of the course in Surgical Methods in Experimental Biology at the Biological Laboratory, Cold Spring Harbor, this summer. Professor George W. Corner, of the School of Medicine of the University of Rochester, will direct the work of the course. He will be assisted by Professor Ernest W. Blanchard, of Bryn Mawr College and Mr. William H. Parkins, of Princeton.

DR. GEORGE B. CRESSEY, chairman of the Department of Geology and Geography at Syracuse University, sailed from San Francisco on June 1 for five months of geographic field work in China. This study is made possible through an appropriation from the National Research Council.

DR. HARVEY CUSHING, Sterling professor of neurology, and Dr. Stanhope Bayne-Jones, professor of bacteriology, will speak before the Association of Yale Alumni in medicine on June 18, and at a dinner to be given in the evening Dr. C.-E. A. Winslow, professor of public health, will speak on "A Physician of Two Centuries Ago."

DR. HAROLD C. UREY, of Columbia, discoverer of heavy hydrogen, delivered a public lecture at the University of Minnesota recently, telling "The Story of the Isotopes." Dr. Urey's lecture was sponsored by the Minnesota chapter of Sigma Xi. He also spoke before the Minnesota chapter of the American Chemical Society and took part in a colloquium of the chemistry faculty.

DR. ARTHUR H. COMPTON, professor of physics at the University of Chicago, will be the commencement speaker at Ohio Wesleyan University, on June 4. Dr. Compton gave two lectures at the Iowa State College under the auspices of the Sigma Xi on May 8, on "The Quest of the Cosmic Ray" and "The Rôle of Science in the New Civilization."

DR. ROBERT F. GRIGGS, professor of botany at George Washington University, gave the annual Sigma Xi address before the University of Cincinnati Section of Sigma Xi, on May 18. His talk, illustrated by lantern slides and motion pictures, was on "The Scientific Results of the Katmai Expeditions."

PROFESSOR LOUIS KAHLENBERG, of the department of chemistry of the University of Wisconsin, addressed the chemists and biologists of northeastern Wisconsin at Appleton at the Institute of Paper Chemistry on May 24, on "The Function of the Sterols in Plant and Animal Life."

PROFESSOR CHARLES SINGER delivered the annual oration on "The Contrast between Ancient and Modern Science" at the London Jewish Hospital Medical Society on May 10.

MORE than three hundred leaders in science and industry were present at Chicago on May 25 to attend the forum on progress sponsored by Alfred P. Sloan, Jr., president of General Motors Corporation. The forum, entitled "Previews of Industrial Progress in the Next Century," was held in the Hall of Progress, General Motors Building, on the grounds of the Century of Progress Exposition, which was officially opened on the following day. Each delegate contributed a statement giving his opinion of what he believes will be "the most important development ahead that might lay a foundation for broad industrial growth." Besides Mr. Sloan, who presided, the speakers were: Charles F. Kettering, vice-president of the General Motors Corporation, in charge of research; Dr. Willis R. Whitney, of the General Electric Company; Dr. Arthur H. Compton, professor of physics, University of Chicago; Walter B. Pitkin, of Columbia University School of Journalism; Carl R. Gray, president of the Union Pacific Railroad; Dr. Morris Fishbein, editor of the *Journal* of the American Medical Association; M. H. Aylesworth, president of the National Broadcasting Company; Glenn Frank, president of the University of Wisconsin, Dr. Robert E. Wilson, director of research for the Standard Oil Company of Indiana, and Harvey Wiley Corbett, architect.

THE London *Times* reports that in accordance with their general plan for reconstruction of the upper floor of the British Museum, the trustees will shortly proceed to reconstruct those parts of the northern galleries of the main building which have not already been undertaken. The first, second and third Egyptian Rooms have already been reconstructed and reopened; progress is being made with the old sixth Egyptian Room, but it can hardly be opened to the public before the middle of next year. There remain the fourth and fifth Egyptian Rooms, and the whole range of smaller galleries (the Syrian, Semetic, Old Babylonian, Assyrian and Persian Rooms) between the northwest and northeast staircases. The Students' Room and offices of the Egyptian Department, together with the approach to the King Edward VII Building, will also be involved. These galleries which are to be reconstructed will be closed to the public from October 1 onwards, but the Students' Room will remain open until October 15. A temporary Stu-

dents' Room will be established as soon as possible in the Assyrian Basement, which will remain closed to the general public. Of the objects thus removed from exhibition it will be possible to exhibit only a few in other parts of the building. Two cases of special interest, containing the Oxus Treasure and the Nimrud Ivories, will be placed in the Front Hall. Other select cases will be placed in the new Babylonian (old sixth Egyptian) Room as soon as that is available. All other antiquities from these galleries will be stored, and it will not be possible to supply information, make photographs, or permit inspection of them during the period of reconstruction. These works are expected to take not less than two years.

DISCUSSION

THE HISTORY OF CHINESE MEDICINE[1]

There is more and more evidence appearing that the silk route from China, although safer in the days of Marco Polo, was never absolutely closed for long periods, although Mohammedans extracted most of the profits from caravans a large part of the time. From China Europe learned not only of printing, the compass, gunpowder and firearms, silk and porcelain, but also alchemy, the deep breathing and exercises now taught in physical education and the diagnosis of disease by means of the pulse. The reason that Europe knew so little of Chinese medicine was not that China was physically isolated, as was Japan, but that Europeans could not read Chinese. The use of alphabets spread over Asia all the way to the Pacific Ocean. Only one people resisted this advance and that was China; whereas Tibetans, Mongolians, Manchurians and Koreans had alphabets. Chinese have always looked upon alphabets with contempt, and "scholarship" in the entire Far East is inseparable from the knowledge of the Chinese characters. It is, therefore, very convenient for us that Wong and Wu have written the "History of Chinese Medicine" in English. Their history is divided into two books, first, that of Chinese medicine and, second, the penetration of western medicine into China. The distinction between Chinese medicine and western medicine was not so great in its early practise, since the basis of most of it has been blood-letting and the administration of herbs and the use of surgery, including anesthetics, but western medicine is entirely different in regard to diagnosis and particularly in the application of scientific discoveries to practise.

Book I

Shen Nung 2838 B. C., the founder of Chinese medicine, is described as a student of pharmacology. He experimented on the effects of drugs on himself. The record of these experiments is compiled in Pen T'Sao, but the editing of an edition of the Pen T'Sao on bamboo is attributed to Huang Ti, 2698 B. C. The characters were arranged in vertical columns, due to the shape of the bamboo. In 651 B. C. the use of a soporific potion in surgery is described. In A. D. 7, Wang Mang orders court physicians to study human anatomy. Smallpox is recorded first in A. D. 49. Chang Chung-ching, 168, greatly advanced medicine by studying the cathartic action of bile and made vital statistics of typhoid fever. In A. D. 180 infection with tapeworm is attributed to eating of raw meat. In A. D. 221 the system of physical exercises is elaborated by Hua T'o and, besides the old soporifics, other anesthetics are described. In A. D. 265 Wang Shu-ho publishes the Mo Ching or pulse-classics. If the pulse was like the snapping of a cord (hyper-tension) death in four days of kidney trouble was predicted. In A. D. 443 medical schools were established, and in 502 Tao Hung-ching published Ming I Pieh Lu, the first official pharmacopœia of China.

Notwithstanding all these advances in medicine another tendency developed. In the centuries just before Christ the idea of the philosopher's stone and the Great Elixir of Life took shape. Alchemy was developed and finally spread to Europe and stifled European medicine as well as Chinese. These alchemical ideas were elaborated into what is called taoism, which dominated China until the modern era. Notwithstanding the shadow of taoism some new observations are recorded, but not particularly elaborated, with the exception of one, which was the inoculation against smallpox discovered about 1063 and which was adopted by Europeans and even spread to America. Wong and Wu state that the use of thyroid gland for goiter is recorded in A. D. 627, but no particular attention was paid to this fact. Tung Chi wrote a monograph on beri-beri in 1078, but Wong and Wu do not tell of any method of prevention.

The evidence is considered conclusive by American studies among the Maya Indians that syphilis was carried to Europe from America. It did not take it long to reach China from Europe, as it is described in Canton in 1505. The Europeans bringing syphilis also founded hospitals, the first being the Misericordia Hospital in Macao in 1569.

Book II

With the advent of the Portuguese and Spaniards, Jean Terrentius, 1621 to 1630, published a human anatomy in Chinese, but it remained for two Catholic fathers to persuade the emperor that the West had

[1] By K. Chimin Wong and Wu Lien-Teh, The Tientsin Press, Ltd., Tientsin, China, 1933. 706 pages; 92 illustrations.

something to give to the East. Fathers Gerbillon and Pereyra brought two pounds of cinchona bark from South America and in 1692 cured the Chinese emperor of malarial fever. From that time on the Chinese were desirous of obtaining western physicians. Quinine and smallpox-vaccine were imported. English and Russian physicians arrived and finally Americans. In 1834 Peter Parker "opened the doors" of China by the introduction of medical service. In 1854 Dr. Hobson successfully employed chaulmoogra oil in leprosy. In 1898 Dr. Kerr gave western medical service to the first patient in an insane asylum in China. In 1904 the University of Pennsylvania established a medical department in Canton Christian College. In 1906 the Peking Union Medical College opened. In 1908 the Yale Mission hospital at Changsha was opened. In 1912 the Harvard Medical School at Shanghai was amalgamated with St. John's. In 1915 the China Medical Board assumed support of Peking Union Medical College.

The "History of Chinese Medicine" is written by Wong and Wu in a classical manner. The Chinese ideograms are reproduced in clear type and the book is indispensable to the student of the history of medicine. One is impressed with the principle, which is as true to-day as it was in the past centuries, that too prolonged adherence to an idea is not very fruitful and that Chinese medicine was greatly retarded by adherence to alchemy.

A list of 26 Chinese medical and pharmaceutical journals is given. No reference to Ma Huang or ephedrine was found.

J. F. McClendon

ECOLOGY OF THE PRAIRIE

Messrs. J. E. Weaver and T. J. Fitzpatrick, of the University of Nebraska, in their recently published study, "The Prairie"[1] supply a most valuable account of this plant community in the United States. Professor Weaver, with the help of his advanced students, has for many years been making studies of grasslands, his work on root systems especially attracting the interest of plant ecologists. In previous papers the climatic and edaphic conditions of the prairie region were described, and the autecology of dominant grasses was fully considered, hence the present monograph, omitting these topics, can and does give in 185 pages a systematic survey of the vegetation itself, its "types," minor communities, the components other than grasses, seasonal aspects, physiological activity, invasion and succession. In all, 135 representative areas of prairie were examined; these are scattered from South Dakota and Minnesota through Nebraska, Iowa and Missouri into Kansas.

The authors conclude that climax prairie is a closed community. There being no open ground for establishment of seedlings, the reproduction is largely vegetative; all the dominant and nearly all the subdominant species are perennials; root systems of different species extend to various depths in the soil, so that the soil water is fully used; layering of subaerial parts secures utilization of available light; rapidity of growth and early maturity characterize the vegetation as a whole, evidently associated with the abundant sunshine throughout the growing season, together with sufficient moisture and high temperatures in June and July.

Two consociations are especially important and wide-spread, dominated respectively by the bluestem grasses, *Andropogon scoparius* of upland areas and *Andropogon furcatus* in moister lowlands. Other grass communities are characteristic of certain edaphic situations: *Spartina michauxiana* Conscoies in poorly drained soils; *Panicum virgatum-Elymus canadensis* Associes in soils somewhat less soggy; *Stipa spartea* Consociation, a bunch-grass community chiefly of the northern and western prairie districts; *Sporobolus heterolepis* Consociation, locally developed on drier hilltops. Typical quadrats show that about 96 per cent. of ground cover is made of grasses and usually less than 4 per cent. is composed of "forbs," *i.e.*, non-grasses. Of the latter the following genera are of most consequence: Achillea, Amorpha, Antennaria, Artemisia, Astragalus, Aster, Erigeron, Helianthus, Petalostemon, and Solidago. Excellent half-tone illustrations are given of these and others.

The authors are to be congratulated upon producing a readable as well as authentic account of one of the great vegetation areas of the world, one which in a few years will no longer be available for study because of man's invasion. Perhaps Messrs. Weaver and Fitzpatrick have not said the last word about the prairie, but they have described it with fullness and accuracy.

Francis Ramaley

University of Colorado

THE AUTOMOBILE AS A DESTROYER OF WILD LIFE

The toll of wild life taken by the automobile on our public highways is far greater than one would naturally estimate. Last summer, while returning to Massachusetts from a motor trip to Iowa, records were made of the wild life lying dead in the highway.

The summer was exceptionally humid, and many animals, more especially turtles, were searching for water. More dead animals were observed in the highway on the trip out than on the return, since rain had fallen in the interim. On a highway extending 100 miles in Ohio, there was an average of one dead rabbit recorded for every mile traveled by auto.

[1] *Ecological Monographs*, 4: 109–295, 1934.

Near one river, I counted 18 dead turtles on 60 running feet of paved automobile road.

A list of animals seen by the driver and listed by an occupant of an automobile which traveled about 500 miles in two days follows:

Bats	3	Rats	2
Birds (unidentified)	34	Skunks	18
Cats	2	Snakes	4
Chipmunks	1	Sparrows	11
Dogs	2	Squirrels (fox)	5
Foxes (red)	1	Squirrels (gray)	1
Mice	2	Toads	13
Moles	4	Turkeys	1
Muskrats	10	Turtles	8
Pheasants	2	Woodchucks	2
Rabbits	11	Woodpeckers	12
		Unidentified animals	30

Considering the vast mileage of highways throughout each state and the number of states, the total animal destruction of wild life on our automobile highways must be gigantic. One sometimes wonders if a good portion of these colossal tragedies could not be prevented by modern, scientific means if the effort were put forth. However, as far as the writer knows, little effort is being put forth to prevent automobiles from destroying countless numbers of our wild life when crossing the highways. Yet, before any effort is put into practise, research must discover a method. Perhaps culverts between swamps, rivers, lakes and brooks where many of the wild aquatics and semi-aquatics migrate might lessen this toll considerably. Through these culverts turtles, muskrats and other aquatics might find a safe means of migration. Furthermore, some of the predators feed on animals which in turn are searching for their food on the highways. The toad loves to hop over the pavement and under bright lights, in the early evening, obtain as his pabulum tiny morsels of insect life. Perhaps the removal of bright lights to margins of the highway through cities and towns would prevent this slaughter.

Paved roads bordered by forests, planted fields and natural waterways seem to take the greatest toll of our wild life. In one stretch of wooded road extending two miles, 200 dead animals were counted. Further data will bring to light the practicability of "animal crossroads" over automobile highways.

WILLIAM H. DAVIS

AMHERST, MASSACHUSETTS

TERMINOLOGY OF ISOTOPES

THE great interest in heavy hydrogen has brought many and sundry suggestions regarding the nomenclature of hydrogen isotopes. It is not the writer's intention to discuss these, sometimes very fanciful, proposals but merely to point to a safe, sane and simple method of naming *all* isotopes. The published lists of isotopes can readily be amended by giving to each isotopic weight an alphabetic letter in the order of the abundance of the isotope, so that *a* always signifies the most abundant, *b* the next abundant isotope.

Tin is very rich in isotopes, and these would be listed as Sn a120, b118, c116, d124, e119, f117, g122, h121, i112, j114, k115; and should occasion arise to differentiate these isotopes in a compound, the terms *i-stannic-a-chloride* or *g-stannous-b-chloride* are sufficiently precise, as well as *i-stannic-aaab-chloride* for mixed isotopes. The various possible forms of ammonia become thus: *aaa-*, *aab-*, *abb-*, *bbb-hydrogen-nitride,* or for short: *mono-b-*, *di-b-*, or *tri-b-hydrogen nitride*. This terminology will fit well into the accepted usage and even high-school students may understand the following series of compounds:

potassium chloride,	$KCl =$	74.463
a-potassium-a-chloride,	$K^{39}Cl^{35}$	74.0
b-potassium-a-chloride,	$K^{41}Cl^{35}$	76.0
a-potassium-b-chloride,	$K^{39}Cl^{37}$	76.0
b-potassium-b-chloride,	$K^{41}Cl^{37}$	78.8

as belonging all to the type of "chlorides of potassium." The only exception to this rule might be made in the case of b-hydrogen (deuterium, diplogen) which shows the greatest physical difference for an isotope and may thus be entitled to a distinct name.

TERMINOLOGIST

IT HAPPENED IN ARGENTINA

IN reply to the inquiry, "Where did this really happen?" made by Edward R. Warren and published in SCIENCE, No. 2039, I am glad to be able to communicate that such an event undoubtedly occurred in Argentina. I recently visited the Church of San Francisco, in Santa Fé, Argentina, as one of a numerous group, and the event in question was mentioned by a resident of Santa Fé, who accompanied us, as one of the items of interest about the church, which was built in 1680. Requesting exact information, I received a few days later a note from one of the Franciscan brothers, giving the date as the 18th of April, 1825. At that time the Paraná River was in flood and the "tigre" entered the convent from a floating island of water hyacinths. One of the Franciscans was killed outright, the other was mortally wounded and died a week later.

While the event as recorded by Darwin is thus fully substantiated, this does not exclude the possibility of a similar occurrence on the Rio Grande.

BERNHARD H. DAWSON

OBSERVATORIO ASTRONÓMICO
LA PLATA, ARGENTINA

CORRECTION OF AN ERRONEOUS STATEMENT

AT the midwinter meeting of the Zoologists in Cambridge I reported some data from an unpublished paper nearly two years in the hands of the editor for the National Museum. (See SCIENCE, March 2, 1934.) In one paragraph I said:

> *Opalina*, a flattened, multinucleate genus, did not evolve from *Zelleriella*, a flat, binucleate genus, as it seems it might well have done by merely acquiring multinucleation. This is indicated by the fact that *Zelleriella* and *Opalina* do not occur and never have occurred in the same locality.

This was a most careless misstatement. There should have been added the clause, "except for the overlapping of the two genera in the late Pliocene Period at the extremities of their migrations in Central America and southernmost United States." In my National Museum paper I had called attention to evidence that *Opalina* was carried by *Rana* from Siberia to North America *via* Alaska in the Tertiary Period, while *Zelleriella*, carried by *Hyla* and Leptodactylids, migrated northward across the Isthmus of Panama to Central America, the West Indies and southernmost United States after the Isthmus was formed at about the middle of the Pliocene Period (Vaughan). The point in mind was that *Opalina* occurred in Euro-Asia and *Zelleriella* in South America at least one geologic period earlier than the time of the first meeting of the two genera after their migration to North America.

My friend, Mr. T. T. Chen, of the University of Pennsylvania, has very kindly directed my attention to my careless misstatement of the true conditions, which I had long ago correctly shown. I thank him very cordially for allowing me to correct my own recent misstatement.

MAYNARD M. METCALF

WABAN, MASS.

SOCIETIES AND MEETINGS

THE ALABAMA ACADEMY OF SCIENCE

THE eleventh annual meeting of the Alabama Academy of Science was held at Spring Hill College, Mobile, Ala., on Friday and Saturday, March 9 and 10. The meeting was called to order at 2 P. M. by President Brakefield. Following addresses of welcome by President John J. Druhan, of Spring Hill College, and City Attorney Harry Seale, speaking for Mayor R. V. Taylor, of Mobile, sectional meetings were begun in which sixty-three papers and three demonstrations were given.

On Friday evening the annual banquet was held in the college dining hall, with about seventy-five members and guests present. At the banquet President Brakefield gave the presidential address on "Samuel Wallace Welch."

On Saturday morning the junior academy held its second meeting with two hundred high-school students, representing six Mobile and nine out-of-town high schools, present. This was almost double the number taking part in the first meeting last year. The new constitution was ratified and officers elected for the coming year. The exhibits were numerous and very good.

The following officers were elected for 1934: *President*, R. S. Poor, Birmingham-Southern College; *Secretary*, P. H. Yancey, Spring Hill College; *Treasurer*, A. G. Overton, Alabama By-Products Company, Tarrant; *Councillor to the A. A. A. S.*, E. B. Carmichael, University of Alabama; *Editor of the Journal*, E. V. Jones, Birmingham-Southern College.

The next meeting will be held April 12 and 13, 1935, at the State Teachers College, Florence, Ala.

P. H. YANCEY,
Secretary

THE TENNESSEE ACADEMY OF SCIENCE

THE 1934 spring meeting of the Tennessee Academy of Science was held at the University of Tennessee, Knoxville, April 26, 27, 28.

Since the meeting of the academy last November at Nashville the executive committee has approved a petition of fifteen members for the formation of a botanical section and applications of the Ornithological Society of Tennessee and The Barnard Astronomical Society of Tennessee for affiliation. The Botanical Section held its first session on the afternoon of Friday, April 27, at which six papers were read and Dr. L. M. Hesler was elected chairman for the year 1934. The first meeting of the affiliated societies with the academy will be at Nashville next November.

The president of the Tennessee Ornithological Society is Dr. George Mayfield, of Nashville. The Barnard Astronomical Society of Tennessee includes: The Barnard Astronomical Club of Nashville, Mrs. Roberta D. Lyne, president; The Barnard Astronomical Society of Chattanooga, Clarence T. Jones, president; The Barnard Astronomical Society of Knoxville, Lilian C. B. McA. Mayer, president.

The board of trustees of the Reelfoot Lake Biological Station elected Dr. A. Richard Bliss, Jr., Memphis, director and three new members of the board: Professor Richard G. Turner, of Martin, Tenn.;

Prof. Charles W. Davis, of Jackson, Tenn., and Prof. George R. Mayfield, of Nashville, Tenn.

The Knoxville Scientific Club entertained the members of the academy at noon on Friday at the Andrew Johnson Hotel. At the dinner on Friday evening, President J. D. Hoskins, of the University of Tennessee, welcomed the members of the academy and Dr. H. A. Morgan of The Tennessee Valley Authority, made an address.

On Saturday afternoon there was an excursion to Norris and the Norris Dam. Sunday morning there were field trips to Mount LeConte and to the bird sanctuary near Knoxville. The Indiana Academy of Science was represented at the meeting by Dr. Stanley A. Cain, professor of botany in the University of Indiana, and the Virginia Academy of Science by Dr. Arthur Bevan, state geologist of Virginia. Dr. Cain read a paper on "Beech-Maple Forests"; Dr. Bevan, a paper on "Recent Work on the Stratigraphy of the Appalachian Valley of Virginia."

JOHN T. MCGILL,
Secretary

SCIENTIFIC APPARATUS AND LABORATORY METHODS

FISHING COLONIES FROM A GELATIN FILM CULTURE

CERTAIN kinds of soil bacteria form in agar or gelatin plate culture very minute punctiform surface colonies which can hardly be discerned by the naked eye. Such colonies can easily be picked out under the microscope from a gelatin film culture, which can be prepared as follows: Test tubes containing about 1.5 cc of melted gelatin are inoculated and, after mixing contents, are once or twice rotated in an oblique position under the cold water tap so that only a thin layer of gelatin coats about two thirds of the inner surface of the test tube, while the rest of the gelatin is allowed to solidify into a slope. After twenty-four to forty-eight hours of incubation at room temperature the colonies can be examined and picked off under the microscope.

To prevent melting of the gelatin a simple cooling apparatus can be made in the following manner: Rubber tubing of about one-inch diameter is filled with cold water, closed on both ends with rubber stoppers, bent in U-shape, bound with two rubber bands and fixed on the microscope stage by means of two other rubber bands; between the arms of the tubing is placed the test tube containing the gelatin film culture. The tubing holds the test tube so firmly that the left hand is left free during the fishing and transplanting of the colonies.

PROCEDURE

Select by means of the microscope a colony of the gelatin film. Take out the cotton plug and put it into a sterile Petri dish. Flame the neck of the test tube. Put into it a sterile platinum wire, the end of which is bent into a small hook. Take care not to touch the wall of the test tube. Push the wire in until its end shades the optical field of the objective. Approach the wire carefully, while looking further through the microscope to the selected colony. After touching it remove the wire carefully and leave its end inside the neck of the test tube, about 2 cm from the top. Take with the left hand a test tube containing a medium to be inoculated; approach it to the right hand, which holds the wire; take off the plug with the little and next finger taking care that during that operation the end of the wire in the neck of the test tube does not touch its wall. Take off the wire and put its end immediately into the test tube and inoculate the medium while approaching the test tube to the flame. Sterilize the neck of the test tube and plug it. Select another colony and transfer it in the same way.

If solid medium is used for inoculation of the picked-out colonies, several of them may be transferred into the same test tube or into a Petri dish.

In this way one can transfer safely hundreds of colonies without any danger of contamination.

Finally take the cotton plug from the Petri dish, flame it and plug the test tube with the original culture and save it if necessary.

The above described gelatin film culture is a modification of Esmarch's "Roll culture" method[1] which has become obsolete in modern bacteriological technique chiefly on account of the low melting point of gelatin, notwithstanding that it is a much cleaner technique than a plate culture.

ANTONI KOZLOWSKI

COLLEGE OF AGRICULTURE
UNIVERSITY OF CALIFORNIA

[1] *Ztschr. f. Hygiene*, I: 293, 1886.

"USE OF SODIUM DIETHYLDITHIOCARBAMATE IN THE DETERMINATION OF MINUTE AMOUNTS OF COPPER"

FOLLOWING the suggestion of Callan and Henderson[1] that the "carbamate reagent" (sodium diethyldithiocarbamate) could be successfully used in the determination of minute amounts of copper colorimetrically, they and other workers have been considerably troubled in certain instances by turbidities developing in the solution after the addition of the reagent. This

[1] Callan and Henderson, *Analyst*, 54: 650, 1929.

made the subsequent procedure of matching the colors difficult and often decidedly unreliable. Thus, an otherwise delicate and accurate method of analysis became under certain circumstances, wholly unreliable.

In some recent work in this laboratory,[2,3] the use of the reagent was often accompanied by pronounced turbidities, and in instances involving relatively large amounts of copper, some actual precipitation resulted. An attempt was made, therefore, to remedy this situation. Considering that the turbidity and precipitation were the result of the coagulation of a colloid, it was at once suggested that some suitable protective agent might solve the problem. With this in view, gum tragacanth and gelatin were used and found to solve the difficulty. Both these colloids were equally effective and satisfactory. Having found a way out of the situation, no other colloids were studied. Undoubtedly there are others quite as suitable for the purpose.

The following outline is offered as furnishing conditions under which satisfactory results may be obtained as indicated by the experience of the writers with the modified method. When the final volume of the carbamate mixture is somewhat less than five cc there is sufficient volume for matching colors in a microcolorimeter, or block comparator. In the latter, small calibrated fermentation tubes or Wassermann tubes are useful. The various proportions used were as follows: 1 to 2 cc of the unknown copper solution; 1 cc of the gelatin or gum tragacanth solution, freshly filtered; 1 to 2 cc of copper free water, depending upon the volume of the unknown used; and 0.6 cc of the carbamate reagent (conc. 0.1 per cent.). The total volume is thus kept at 4.6 cc.

When graduated pipettes are used in the measurements, the errors obtained in matching a series of ten standards (0.01–0.10 mg) against a duplicate set of standards were found to lie between 0.0001 and 0.0020 mg of copper. If a microburette is used with a similar set of standards, the errors between the observed and calculated values lie between 0.0001 and 0.0010 mg of copper. The accuracy may be improved by selecting the range of standards lying between 0.01–0.04 mg, where the errors were found to be less, namely, 0.0000 to 0.0006 mg of copper.

A preliminary determination on the unknown will show the dilution necessary to make it fall within the more accurate range, *i.e.,* 0.005 to 0.04 mg of copper in one cc of the solution.

The reduction in the amount of the unknown, as described above, makes it possible to begin with an amount of original material containing from 0.05 to 0.40 mg of copper and subsequently dilute the volume of the unknown to 10 cc. This volume is ample for making from four to nine determinations, depending upon the copper concentration.

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MARGARET C. MOORE
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SPECIAL ARTICLES

THE THIRD MAJOR MECHANICAL FACTOR IN THE CIRCULATION OF THE BLOOD[1]

NEARLY 25 years ago during studies on the heart and the circulation of the blood Henderson[2] was led to the opinion that besides the heart and the vasomotor nervous control of the blood vessels there must be a third factor in the circulation. It is the factor that sends the blood back to the heart through the veins. Without it the blood would stagnate in the tissues instead of returning to the heart. To the factor that insures the venous return to the heart he gave the name of the "Venopressor Mechanism."

In spite of a vast deal of work no one has succeeded in defining just what the venopressor mechanism is. It is important to know: for it is the failure of this third mechanical factor in the circulation, rather than that of either the heart or vasomotor system, that causes the weakened circulation of the blood following illness and the extreme depression of the circulation in surgical shock.

There have been many attempts to explain the variations of the venous return and their regulation by contraction or relaxation of the veins. The vasomotor nervous system influences veins as well as arteries. But no explanation of the venous return under vasomotor regulation that is mechanically satisfying has been developed. Experimentally it was found by Henderson and Harvey[3] that, if the entire vasomotor mechanism is stimulated by an injection of adrenalin, both arterial and venous pressures rise. But if the injection of this vasomotor stimulant is continued, only the arterial pressure is maintained; venous pressure falls again to its former level. Clinically also adrenalin fails to restore a de-

[2] Moseley and Rohwer, "The Determination of Minute Amounts of Copper," unpublished thesis, 1933, Tulane University.

[3] Moore and Moseley, "Examination of Oyster Liquors for Copper," unpublished report, 1933, Tulane University.

[1] Read before the National Academy of Sciences on April 24.

[2] Y. Henderson, *Am. Jour. Physiol.*, 27: 152, 1910.

[3] Y. Henderson and S. C. Harvey, *Am. Jour. Physiol.*, 46: 533, 1918.

pressed circulation; it does not restore and maintain a normal volume and pressure of the venous return.

William Harvey 300 years ago recognized that every contraction of a muscle drives blood into the veins and on toward the right side of the heart. Every text-book describes this action. But this fact does not explain how, when a healthy man is lying motionless and relaxed, the blood is sent back to the heart. It does not explain why the force causing the venous return is so much diminished in states of physical depression.

It is well known that in health, even during complete bodily rest, every muscle in the body has tonus: that is, it exerts a slight pull. It is also well known that in physical depression, such as occurs even after an attack of influenza, the tonus of the muscles of the body is lessened. Simultaneously the circulation is weakened. But the lowering of general body tonus has always been imputed to the poor circulation. In reality, as our results indicate, the poor circulation is largely due to the lowered body tonus.

We propose now to reverse the present conception of cause and effect. We have reached the conclusion that the tonus of the muscles of the body is the principal force involved in the venous return. We have determined experimentally that a muscle in a state of tonus has an internal pressure. This pressure amounts to 50 to 70 mm of water column, even during complete rest. When muscle tonus is increased, this pressure is higher: up to 90 mm or more. When tonus is abolished the internal pressure is also abolished.

Our method of measurement is to thrust a hypodermic needle into the middle of a muscle, usually the biceps, and to determine the pressure required to cause a minute amount of saline to run in. We find that the intramuscular pressure varies with the tonus of the muscle. It is too small to have any considerable direct effect upon arterial blood pressure and flow into a muscle; but quite sufficient to exert a strong influence upon the venous outflow from a muscle.

Of course the so-called *vis à tergo,* the push from behind, imparted to the blood by the left heart, is the force that drives the blood into the vessels in the muscles. If the muscles have tonus a part of this force is taken up by their elasticity and presses the blood on into the veins leading to the right heart. But in the absence of muscle tonus the entire force of arterial pressure is lost in the flaccid tissues and the blood stagnates there instead of flowing on back to the right heart.

These mechanical relations are best understood by comparing them to the circulation of water in the atmosphere. The sun by its heat lifts water from the sea into the clouds. It supplies the energy, as the heart does in pumping blood from the low pressure in the veins up to the high pressure in the arteries. Meteorological conditions determine where rain shall fall, much as the vasomotor system controls the distribution of the arterial blood to the various organs. If the rain falls on mountains or a high plateau, the water runs back to the sea with a force that can be used to turn mill wheels or produce hydroelectric power. Such streams from high levels are analogous to the venous blood streams from muscles in good tonus.

If, on the contrary, the rain falls on a swamp at sea level or other low ground, the stream back to the sea is sluggish. Similarly, when the tonus of all the muscles in the body is low, the venous stream to the heart is sluggish. And because of the diminished venous supply to the heart the volume pumped by the heart into the arteries is diminished and the entire circulation is depressed.

It is not merely by positive pressure that muscle tonus promotes the flow of blood to the right heart. The negative pressure in the chest, which draws the venous stream toward the heart, likewise varies with the tonus of the thoracic muscles. After surgical operations and anesthesia involving even a slight degree of depression of vitality, or shock, the tonus of the diaphragm is decreased, and because of the relaxation of this muscle the so-called vital capacity of the lungs is diminished. In cases of considerable depression a partial atelectasis, or even a massive collapse of the lung, may develop. This relaxation of the diaphragm, established by x-ray observations, first suggested to us the relation of muscle tonus to the circulation.[4]

It has now become the general practise of anesthetists to terminate anesthesia with an inhalation of carbon dioxide. Surgeons find that this inhalation prevents atelectasis. It produces this result largely by increasing the tonus of the diaphragm. The lungs are thus expanded, and both the negative pressure in the thorax and the positive pressure in the abdomen are increased. As the anesthetic is eliminated, the increase of muscle tonus all over the body induces a rapid restoration of the pressure and flow of the venous stream to the heart and a corresponding increase in the volume of blood pumped into the arteries by the heart.[5]

This conception of the influence of bodily tonus upon the venous return affords a clear picture also of the relation of heat production and metabolism to respiration and the circulation. Basal metabolism is largely determined by the tonicity of the muscular

[4] For literature see Y. Henderson, *Jour. American Medical Association,* 95: 572, 1930.

[5] Y. Henderson, H. W. Haggard and R. C. Coburn, *Jour. American Medical Association,* 74: 783, 1920.

tissues of the body. The amounts of oxygen consumed and carbon dioxide produced determine the volume of the circulation needed to transport these gases between the tissues and the lungs, as well as the volume of respiration needed to exchange them with the atmosphere.

We can now see that muscle tonus, itself controlled from the central nervous system and considerably influenced by the respiratory center, is the basic factor determining both the amount of metabolism and the correlated volumes of the circulation and respiration.

In particular, we conclude that muscle tonus is a factor of prime importance in the venopressor mechanism.

YANDELL HENDERSON
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A SPECIES AND GENUS OF FRESH-WATER BRYOZOON NEW TO NORTH AMERICA

FOUR years ago while collecting fresh-water bryozoa for class purposes in the Delaware and Raritan Canal at Princeton, New Jersey, the writer found on the leaves of water plants small colonies, of from four to thirty polyps each, which were at first taken for very young colonies of *Pectinatella* or possibly colonies of this form which remain flat without forming the prominent globular mass of jelly that usually characterizes this species. It was noticed, however, that the colonies were not round but roughly triangular in shape, with the polyps mostly on one side and the opposite angle well drawn out. It was then seen that

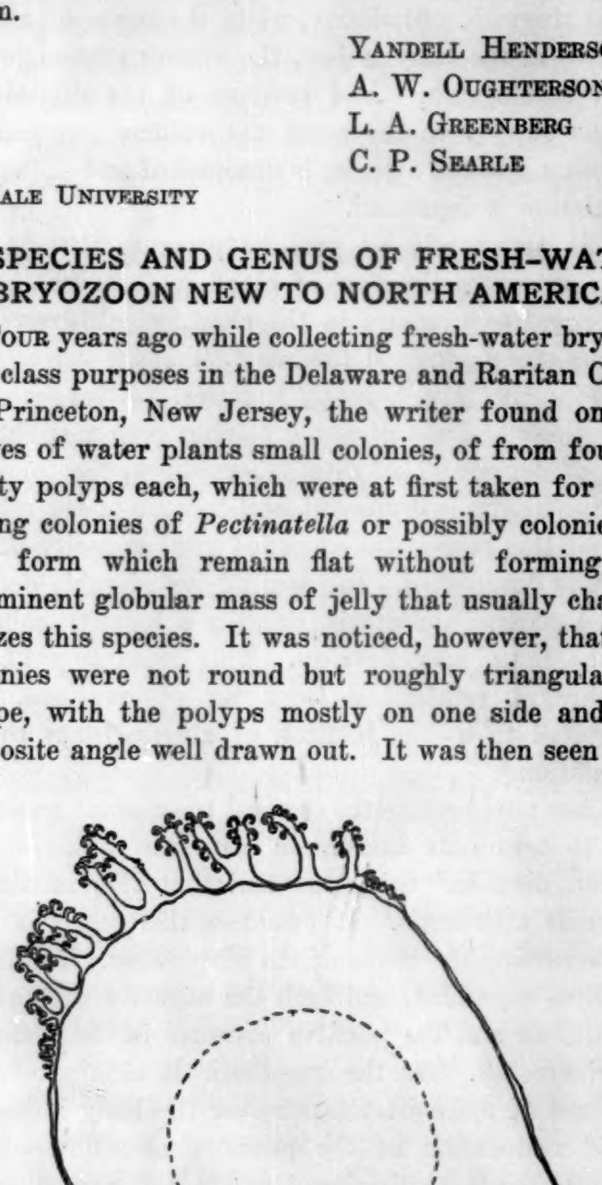

FIG. 1

the colonies were freely motile, moving up to as much as three or four inches per day. They were then surmised to be the genus *Lophopus* until an examination of the statoblast showed the swim-ring (Fig. 1) to be an elongate oval over a millimeter in length with a group of rod-like projections at each end, each rod bearing from two to eight strongly curved hooks. This was so remarkably different from any of the other hook-bearing statoblasts of the Phylactolaemata that it was realized that the species was new to America at least.

The phylactolaematous bryozoa of eastern North America had been so faithfully collected and studied by Leidy, Hyatt, Potts, Davenport and a host of others that it seemed impossible that this very abundant form could have been overlooked.

It was found that the genus had been recorded by H. J. Carter in Bombay, India, from a single statoblast in 1859. He called it a species of *Lophopus*. In 1881 Hyatt recognized that it was not a *Lophopus* and made it a new genus *Lophodella carterii*, naming it after its first discoverer. Annandale has found it abundantly and widespread in India in 1911. Kraepelin in 1906 and Vorstman in 1927 describe it from the East Indies and Siam, etc. Oka in 1906 describes it from Japan and Ulman in 1907 from equatorial Africa. Wherever it grows, it is very abundant, literally covering the leaves of plants as well as sticks and stones in favorable seasons. How then did it escape Leidy and his followers only forty miles from Philadelphia?

The writer concludes that it is a recent introduction, from India probably. He has collected extensively in the fresh waters around Princeton since 1890 and had never seen it until four years ago when it was abundant in the canal, but not in the lake or other Princeton streams or ponds. Last season, 1933, it appeared in the lake and Millstone River in abundance. It will be interesting to trace its further spread. The statoblasts are very resistant and could have been easily transported from India and introduced into the canal on many kinds of cargo. It resists the winter, although it comes from a warm source. It is a beautiful form, splendid for class work, easily kept in aquaria and easily expanded for study. The body is clean, not dirty, like *Plumatella*.

ULRIC DAHLGREN

PRINCETON UNIVERSITY

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